

APPENDIX E

LAUNDRY WASHING FORMULAS

All formulas listed in this appendix are based on a 60-pound clothing load for the M85-series mobile laundry units. To conserve time, manpower, and energy, all machines should be fully loaded when processing laundry, unless otherwise stated. Water level, length of time, and temperature for each operation are shown with each formula. Following laundry (washing) actions are implemented.

- *Items of similar fabric construction and types should be laundered together.* However, take care when laundering items containing blended materials such as cotton and wool and polyester and wool blends. Blended materials should be laundered according to laundering procedures for wool items. Antiredispersion agents may be added when laundering natural and synthetic blended materials. To better clean heavily soiled items, a prespotting agent may be used.
- *The detergent types listed can be used with good results in both soft and hard water.* When the supply of fresh water is low, seawater can be used if type II detergent is used in twice the amount shown for each suds operation. Fresh water should be used for the last two rinses.
- *Some detergents listed in formulations contain phosphates and should be used only in those areas where allowed by law.* The laundry manager should consult with the higher headquarters and local (i.e. state) EPA agency for guidance in this area. Alternate, nonphosphate-containing detergents are listed in the back of this appendix along with a complete list of laundry items.

NOTE: Laundry decontamination is not a mission performed by the QM FSC. However, due to METT-TC and directions from higher headquarters, the QM FSC, DS (or Modular) may assume the requirement to provide this support as needed.

Formula I. In Table E-1 formula I is used to decontaminate cotton, synthetic, and cotton and synthetic blends that are radioactively contaminated below the maximum tolerance level. A bleaching agent should be used white clothing is being laundered. About 3 ounces of bleach (80 to 100 PPM) is placed in the third sudsing operation. When bleach is used, 1.5 ounces of anti-chlor sodium thiosulfate is added in the second rinse operation. Extract for two minutes. Tumble dry at 150°F.

Table E-1. Formula I

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	Low	5	Lukewarm (100/38)	Detergent, type I, 6 oz
Suds	Low	5	Hot (130/55)	Detergent, type I, 4 oz
Suds	Low	5	Hot (140/60)	Detergent, type I, 2 oz
Rinse	High	2	Hot (140/60)	-----
Rinse	High	2	Warm (120/49)	-----
Rinse	High	2	Lukewarm (100/38)	Sour, 2 oz

Formula II. In Table E-2 formula II is used to launder sleeping bags (turn bag inside out, close zipper, and tie neck opening), polypropylene underwear for the ECWCS, and woolen items such as blankets, winter underwear, and socks. Three ounces of commercially available quarternary ammonium softener and bacteriostat is added in the second rinse (low water level) for underwear items. To reduce shrinkage and strain on the items, the washer should be fully loaded and stopped during filling and draining. Allow the extractor to reach top speed, and then shut it off. Be sure the tumbler is fully loaded. Dry sleeping bags are placed in tumbler at a temperature not exceeding 130°F. Dry polypropylene underwear at a temperature not exceeding 110°F. Dry woolen items at a temperature not exceeding 120°F.

Table E-2. Formula II

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	High	5	Lukewarm (90/32)	Detergent, type II, 6 oz
Suds	High	5	Lukewarm (90/32)	Detergent, type II, 4 oz
Rinse	High	2	Lukewarm (90/32)	-----
Rinse	High	2	Lukewarm (90/32)	-----
Rinse	High	2	Lukewarm (90/32)	Sour, 2 oz

Formula III. In Table E-3 formula III is used to launder hospital garments and linen items. A bleaching agent and sodium thiosulfate are used for white items only. Extract for two minutes and dry at 150° to 160°F. See Formula IX for laundering white cotton polyester nursing uniforms.

Table E-3. Formula III

Water Operation	Level	Time (min)	Temperature °F/°C	Supplies
Flush	High	2	Warm (110/43)	-----
Suds	Low	8	Warm (110/43)	Detergent, laundry, liquid-cold, 9 oz
Suds	Low	8	Warm (110/43)	Detergent, laundry, liquid-cold, 4 oz
Flush	High	2	Warm (110/43)	-----
Bleach (whites)	Low	9	Warm (110/43)	Bleach, sodium hypochloride, 4 oz (100-150 PPM)
Rinse	High	2	Cold (80/27)	-----
Antichlor	High	2	Cold (80/27)	Sodium thiosulfate, 1.5 oz
Rinse	High	2	Cold (80/27)	-----
Sour/softener	Low	5	Cold (80/27)	Sour, laundry, 3 oz
				Bacteriostat
				Softener, 3 oz (pH 6.5-7.0)
Antistat*	Low	5	Cold (80/27)	24 oz by volume
*Note: If antistat is required, dilute antistatic agent with equal amounts of water before adding it to the load.				

Formula IV. In Table E-4 formula IV is used to make outer clothing, such as field wear and raincoats, water-repellent. Soiled garments sometimes lose repellency. If the garments show poor water-repellency after they are laundered and dried, they should be treated again. Treated garments are never starched. Be sure that the final rinse operation contains no residual suds. Sudsing interferes with the water repellency of the clothing items. More rising may be needed. Dry according to the care label instructions on the garment.

*Table E-4. Formula IV**

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	Low	5	Lukewarm (100/38)	Detergent, liquid-cold, 5 oz
Suds	Low	5	Lukewarm (100/38)	Detergent, liquid-cold, 3 oz
Rinse	High	2	Lukewarm (90/32)	-----
Rinse	High	2	Lukewarm (90/32)	-----
Rinse	High	2	Lukewarm (90/32)	-----
Rinse	High	2	Lukewarm (90/32)	-----
Water-repellent treatment	High	10	Lukewarm (90/32)	Compound, water-repellant, textile-finish, type I, aqueous, 3 pints
*Note: Not for Quarpel-treated items.				

Formula V. In Table E-5 formula V is used for mothproofing woolen items before they are stored for the summer or returned to stock. After washing the clothing, place items in extractor for two minutes. Dry the clothing at a temperature not exceeding 130°F/55°C. In a separate container, add 1 ounce Permanonce 40 EC to 1 quart of water (100°F). Add 5 ounces of commercial liquid fabric softener to Permanone and water solution. Stir well and add to final rinse water.

Table E-5. Formula V

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	High	5	Lukewarm (100/38)	Detergent, type II, 6 oz
Suds	High	5	Lukewarm (100/38)	Detergent, type II, 3 oz
Rinse	High	3	Cold (80/27)	-----
Rinse	High	3	Cold (80/27)	-----
Rinse	High	3	Cold (80/27)	-----

Formula VI. In Table E-6 (page E-4) formula VI is used to decontaminate clothing that is radioactively contaminated above the maximum tolerance level. For woolen clothing, change the formula to use type II powder detergent with water temperature of not more than 100°F/38°C. Also, the wash-extractor cylinder must be fully loaded and stopped during filling and draining. For white clothing or bedding, a bleaching agent should be used. An organic chelating agent, tetrasodium salt of ethylene diaminetetraacetic acid, is available commercially as Versene, Nullapon, or Sesquestrene. When hard water is used, the amount of chelate should be increased at the rate of 1 ounce chelate per 83 grains of water hardness. An equal weight of sodium hexametaphosphate or sodium tetrphosphate may be substituted for

the organic chelating agents. Dry cotton and synthetic items at 150°F and woolen items at a temperature not exceeding 120°F.

Table E-6. Formula VI

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	Low	5	Lukewarm (90/32)	Detergent, type I, 6 oz
Acid	High	5	Hot (140/60)	Citric acid crystals, 4 lb
Acid	High	5	Hot (140/60)	Citric acid crystals, 2 lb
Chelate	High	5	Hot (140/60)	Chelating agent, 1 lb dry weight
Rinse	High	3	Hot (140/60)	-----
Rinse	High	3	Warm (120/49)	-----
Sour	High	5	Tap water	Laundry sour, 1 1/2 oz (use equal parts of sodium silicofluoride and sodium acid fluoride)

Formula VII. In Table E-7 formula VII is used to launder and decontaminate chemically or biologically contaminated unimpregnated cotton, synthetic, and woolen items. Detergent and super tropical bleach (NSN 6850-00-264-8942) must be mixed together in water before they are put in the washer. Cotton and woolen items must not be put in the same wash load. When items such as belts, webbing, canteen covers, and pack carriers are washed, the time of the first suds should be increased to 15 minutes. Extract for two minutes and tumble dry cotton and synthetics at 150°F. Tumble dry wool at a temperature not exceeding 120°F.

Table E-7. Formula VII

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	High	5	Lukewarm(90/32)	Detergent, type II, 6 oz; decontaminating agent; super tropical bleach (STB), 2.5 lb
Suds	High	5	Lukewarm(90/32)	Detergent, type II, 4 oz
Rinse	High	2	Lukewarm(90/32)	-----
Rinse	High	2	Lukewarm(90/32)	-----
Rinse	High	2	Lukewarm(90/32)	Sour, 2 oz

Formula VIII. In Table E-8 (page E-5) formula VIII is used to launder durable press garments and BDUs. Load the washer with 60 pounds of laundry. Load the extractor with 30 pounds from the full 60 pounds wash load. Type II detergent is used when laundering BDU items. To prevent the setting of creases, allow the extractor to reach top speed and shut it off immediately. Do not wring or twist garments. DO NOT STARCH, BLEACH, OR PRESS BDU ITEMS; however, this recommendation is left up to the post commander to do otherwise. (See Table E-12, page E-8, for a new wash formula for ECWCS PTFE parka and trousers.)

Table E-8. Formula VIII

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	High	8	Warm (110/43)	Detergent, laundry, liquid-cold, 4 oz
Suds	High	6	Warm (110/43)	Carry-over
Rinse	High	3	Lukewarm (90/32)	-----
Rinse	High	3	Lukewarm (90/32)	-----
Sour	Low	3	Lukewarm (90/32)	Sour, laundry, 3 oz

Formula IX. In Table E-9 formula IX is used to launder white cotton-polyester nursing uniforms. Loads in washer and dryer must not exceed two-thirds of their capacity. The washer should be stopped during filling and emptying. Before placing the uniforms in the washer, close the zipper and snap fasteners. Extract for two minutes, and tumble dry at 150°F.

Table E-9. Formula IX

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	High	12	Warm (110/43)	Detergent, low temp, 6 oz
Suds ¹	High	10	Warm (110/43)	Detergent, low temp, 6 oz
Rinse	High	2	Cold (80/27)	-----
Rinse ²	High	2	Cold (80/27)	-----
Sour	High	4	Cold (80/27)	-----
Rinse	High	8	Cold (80/27)	Sour/softener
Antistat ³	Low	5	Cold (80/27)	24 oz by volume

¹If bleach is required, use at the rate of 2 quarts of 1-percent bleach or 2 ounces of dry bleach (15 to 16 percent available chlorine) per 100 pounds of garments. Dilute with water before adding.

²If bleach is used, add anti-chlor sodium thiosulfate at the rate of 1 ounce per 100 pounds of clothes.

³Dilute antistatic agent with equal amounts of water before adding.

Formula X. In Table E-10 formula X is used to launder white arctic snow camouflage clothing. The presence of any detergent in the last rinse has a detrimental effect on water-repellency of garments. Further rising may be necessary to prevent residual detergent sudsing. After washing the garment, extract for two minutes. Tumble dry at 160°F.

Table E-10. Formula X

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Prespotting Agent	-----	-----	-----	-----
Suds	Low	8	Hot (130/54)	Detergent, low-phosphate, type I, 6 oz
Suds	Low	8	Hot (130/54)	Detergent, low-phosphate, type I, 3 oz
Rinse	High	2	Hot (150/66)	
Bleach	High	8	Hot (160/71)	Hydrogen peroxide* 30%, 12 oz
Rinse	High	5	Hot (140/60)	
Sour/ *Optical Brightener	High	4	Lukewarm (100/38)	Sour, 3 oz/optical brightner, 3 oz
*Available from laundry supply houses.				

Formula XI. In Table E-11 formula XI is used to rejuvenate the antistatic properties of Nomex/Kevlar uniforms.

Table E-11. Formula XI

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	Low	8	Warm (120/49)	Detergent, low-phosphate, type I, 7 oz
Suds	Low	10	Warm (120/49)	Detergent, low-phosphate type I, 4 oz
Rinse	High	2	Warm (110/49)	-----
Rinse	High	2	Lukewarm (100/38)	-----
Sour	Low	2	Lukewarm (90/32)	Sour, laundry, 2 oz
Antistatic Agent ^{1,2}	Low	5	Lukewarm (90/32)	Antistatic, 24 oz

¹Dilute the antistatic agent, NSN 7930-00-965-9830 (P-R-1420), with at least an equal amount of water before adding it to the load. An antistatic agent may be obtained from E. I DuPont De Nemours EI and Company under the trade name Avetex DN.

²The U.S. Army Natick Research, Development and Engineering Center has completed extensive laundry tests to determine the durability of the antistatic finish applied on the Nomex/Kevlar fabrics used by the Army. The effectiveness of the antistatic laundry treatment was also part of this study. In light of the information obtained in this study, previous information regarding the retreatment of Nomex/Kevlar has been revised and the recommendations should be followed:

- All current Nomex/Kevlar uniforms should be retreated with an anti-static finish, Natick Formula X for post laundry or Formula IX as specified in the reference for the field, every time uniforms are laundered in the field or on post.
- When laundering Nomex/Kevlar uniforms at home or in the barracks, a chemical laundering softener should be used either in the wash or drying cycle each time the garments are laundered.

Formula XII. In Table E-12 formula XII is used to launder and restore the water repellency properties of the ECWCS PTFE parka and trouser. Type II detergent is used. **DO NOT STARCH, BLEACH, DRY CLEAN OR PRESS ITEMS.** Dry parka and trouser at a temperature not to exceed 150°F.

Table E-12. Formula XII

Operation	Water Level	Time (min)	Temperature °F/°C	Supplies
Suds	High	12	Warm (110/43)	Detergent, type II P-D-245, 6 oz
Rinse	High	4	Lukewarm (90/32)	None
Rinse	High	4	Lukewarm (90/32)	None
Rinse	High	4	Lukewarm (90/32)	None
Sour	Low	4	Lukewarm (90/32)	3 oz
Water Repellent ¹	Low	5	Lukewarm (90/32)	20 oz for 40 lb of clothing ²

¹The National Stock Numbers for approved water repellents to be used on ECWCS are 8030-01-408-9444 (5 gallons) and 8030-01-408-9445 (55 gallons). These products can be purchased through GSA and they are the only approved water repellent compounds that can be used to restore the water repellency of these items and provide the performance level required to protect the soldier from the elements.

²This amount is based on 40 pounds of clothing which is equivalent to 0.5 oz per pound of clothing.

Table E-13. Laundry supplies

Item	National Stock Number	Container Size	Federal or Specification
Bleach, Laundry, Sodium Hypochlorite	6810-00-598-7316	1 gal	NA
Citric Acid	6810-00-141-2942	50 lb	MIL-C-11029C
Chelating Agent ¹	Commercial Product	NA	NA
Decontaminating Agent STB	6850-00-297-6653	50 lb	MIL-D-12468B
Detergent, Low-Phosphate (type II)	7930-00-929-1220	50 lb	P-D-245E
Detergent, Nonphosphate (type II)	7930-00-252-6797	50 lb	P-D-245E
Detergent, Laundry, (Liquid-Cold Water)	7930-01-214-8777	5 gal	MIL-D-44160
Detergent, Low Temperature Nonphosphate ²	Commercial Product	NA	NA
Permano 40 EC ³	Commercial Product	NA	NA
Prespotting Agent	6810-01-015-7939	1 gal	MIL-S-43910
Sodium Thiosulfate Anti-Color	6750-00-292-8190	100 lb	O-C-275C
Sodium Tetra- phosphate (Chelating Agent Substitute)	6810-00-949-8332	100 lb	NA

Table E-13. Laundry supplies (continued)

Item	National Stock Number	Container Size	Federal or Specification
Softener/Bacteriostat ⁴	Commercial Product	NA	NA
Sour, Laundry	7930-00-291-8321	50 lb	A-A-1374
Water-Repellent Compound (Aqueous System) (type I)	8030-00-264-3875	5 gal	TT-W-156B
¹ A commercial chelating agent is tetrasodium salt of ethylene diamine tetraacetate. Trade names include Sequestrene, Nullapon, and Versene. ² Commercial detergents procured locally. Trade names include Liquid Tide and Era Plus. ³ A commercial product that may be obtained from Fairfield American Corporation, Medina, NY 14103. ⁴ Commercial products containing Quaternary Ammonium compounds. They are procured locally.			